



Public Works Department • Engineering Division • 702 Edgebrook Drive • Champaign IL 61820
(217) 403-4710 • fax (217) 403-4755 • www.ci.champaign.il.us

May 9, 2012

Re: Attached Report by Daily & Associates, Engineers, Inc., dated January 26, 2005.
“Parking Lot J Engineering Services, G6 Project, Effect on Existing Parking Lot J,
Boneyard Creek Structure”

This report was developed for two projects that were not constructed. The parameters used for the analysis are indicated in the report. Use of this information for a different project will require additional professional interpretation. This analysis shall be used only when the proposed project parameters fall within the stated parameters of this report.

Note that the report evaluates only the sheet pile section of the Boneyard Creek channel and not the junction chamber constructed as part of the Campustown Channel Improvements.

Eleanor Blackmon
Assistant City Engineer



Daily & Associates, Engineers, Inc.
MUNICIPAL • TRANSPORTATION • STRUCTURAL
ENVIRONMENTAL • LAND PLANNING & DEVELOPMENT

RECEIVED

JAN 27 2005

Engineering Division

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January 26, 2005

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City of Champaign
Public Works/Engineering Division
702 Edgebrook Drive
Champaign, IL 61820
Attn: Roland White, P.E. Assistant City Engineer

RE: Parking Lot J Engineering Services
G6 Project, Effect on Existing Parking Lot J
Boneyard Creek Structure

Dear Mr. White:

This report of investigation was authorized by Mr. Roland White of the City of Champaign on January 4, 2005 for the following purposes:

1. To determine allowable vehicle loads on the existing Boneyard Creek Structure as affected by the proposed construction of the G6 Project facilities at the northwest corner of 6th and Green Streets by JSM Development, and the parking garage to the north by Desman Associates for the City of Champaign.
2. To determine the effect of proposed building foundation loads adjacent to the Boneyard Creek Structure at Lot J on this structure, and determine general required horizontal distances from the existing structure and corresponding minimum foundation depths to avoid overstressing the existing structure, specifically the sheet piling, assuming no modifications or enhancements to the existing structure.

EXISTING STRUCTURE

The existing Boneyard Creek Structure was constructed in 1968, and modified in 1998. It consists of a precast concrete deck beam superstructure of 1'-6" deep beams, supported by a reinforced concrete pile cap at the top of MP-116 (PDA-27) sheet pile retaining walls/abutments. A 12" concrete base slab was constructed in 1998 at an approximate top elevation of 705, between the sheet piling along the channel streambed. Exhibit 3 contains a cross-section of the existing structure. The existing site is paved for pedestrian and vehicular use.

PROPOSED STRUCTURE FOUNDATIONS

The proposed JSM Development structure to the south of the existing Boneyard Creek is a multistory residential/retail facility to be founded on reinforced concrete shallow spread

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footings at a desired elevation of approximately 5 feet below final grade, or deeper drilled pier foundations where needed. A partial foundation plan for those foundations adjacent to the structure on the south side of the Boneyard Creek was furnished by JSM with proposed footing locations and loads (see Exhibit 1a), including continuous footings at the north stair tower and building perimeter. The footing locations nearest the existing structure range from 6.5 ft to 34 ft from the centerline of column to the face of the south sheet piling of the existing Boneyard Creek structure.

The proposed Desman Associates structure to the north of the existing Boneyard Creek is a multistory parking garage to be supported on foundations at an unspecified desired elevation or type. A foundation plan was furnished by the City of Champaign with proposed footing locations (see Exhibit 1b). The columns are spaced at approximate 60 ft centers in the east-west direction, and at approximate 25 ft centers in the north-south direction. The total column load for a perimeter non-corner column was also supplied. The footing locations nearest the existing structure range in proximity from 7.5 ft to 24 ft from the centerline of column to the face of the north sheet piling of the existing Boneyard Creek structure.

ANALYSIS METHODS

The existing Boneyard Creek Structure was designed based on an HS-15-44 (54,000 lbs) truck with an impact factor of 30% to account for dynamic load effects, in accordance with the AASHTO Standard Specifications for Highway Bridges. Impact factors for highway bridges are based on a vehicle design speed of 70 mph. Dynamic effects are somewhat related to vehicle velocity. In determining a load rating for the existing structure for its new use to support service vehicles in a short dead end alley, a reduced impact factor of 10% was used, based on a reduced assumed design vehicle velocity of 20 mph. The reduced impact factor is based on information presented in a paper published by the Virginia Transportation Research Council, in cooperation with the Virginia Department of Transportation, titled "Effect of Design Parameters on the Dynamic Response of Bridges". The precast deck beams are checked for adequacy for the specified truck loads by distributing the vehicle wheel load per the AASHTO requirements. The sheet piling is checked for vertical load capacity using skin friction values from the IDOT Geotechnical Manual Chapter 3, based on information contained in the soil borings from the existing structure plans dated 1968. See Exhibit 2 for soil borings.

The effects of the proposed structure foundations on the sheet pile retaining walls are determined based on the following assumptions and design methods. The piling is considered supported at its top and at the concrete strut at elevation 705. The coulomb theory of earth pressure, as presented in the USS Steel Sheet Piling Design Manual, is used to determine active and passive earth pressures, based on a $\phi = 30^\circ$ and wall friction angle of 11° . The groundwater level behind the sheet piling is assumed to be 2 ft higher than the stream water level, and a 2 ft live load surcharge is used to account for vehicular loads at grade. The horizontal surcharge effects of the proposed footings on the sheet piling are determined using Terzaghi modified Boussinesq equations based on the theory of elasticity, for a strip load (column footings) or a line load (continuous wall footings).

For the column footings, clear zone envelopes, representing the closest allowable distance from the bottom of footing to the sheet piling, are determined to avoid overstressing the sheet piling. This involves investigation of different cases using various depths and column foundation loads. From the range of foundation loads provided by JSM and Desman, four column footing load magnitudes are selected for investigation. The geometry of the strip load used to represent the footing is based on an estimated 4000 psf allowable footing bearing pressure assuming a square spread footing. The column surcharge loads are applied at two depths, elevation 713 and elevation 705, approximately 5 ft and 13 ft below grade respectively. For the various surcharge loads, the magnitude of passive pressure engaged in resisting the active forces is based on the assumption that full passive pressure would be engaged at a pile deflection of $0.01H$, or approximately 1" at the pile tip. Using an allowable stress of $0.55F_y = 21,175$ psi, and a section modulus based on a 50 yr 10% corrosion section loss, the allowable moment in the sheet piling is determined, and the footing (surcharge) horizontal distance to the sheet piling is varied until the applied bending moment is less than the allowable bending moment, to determine the clear zone required.

For the continuous footings, the largest loaded footing with the closest proximity is checked to determine whether the sheet piling would be overstressed or not. The horizontal surcharge is determined for one case, based on the footing's current location shown on the partial foundation plan, by applying the surcharge at a distance of 10 ft from the sheet piling, at elevation 713, approximately 5 ft below grade. Assumptions regarding the soil behavior and sheet pile bending properties are the same as noted above.

RESULTS OF ANALYSIS

The existing structure is rated to allow an HS-18 truck, with a 10% impact factor, and 64,000 pounds total gross vehicle weight, and if desired could be posted "Maximum Vehicle Load – 64,000 Lbs GVW, Maximum Axle Load – 28,000 Lbs."

The minimum clear zone required between the edge of the proposed footings and the sheet piling is summarized in the envelopes presented in Exhibit 3. These envelopes are based on a line fit through the minimum distances determined for the two depths investigated, plus the following. For any column load, if the bottom of footing elevation is at elevation 696 or below, the clear distance required is zero, since the pile tip elevation is 696, and therefore the footing would have no horizontal surcharge effect on the existing sheet piling.

The sheet piling is within allowable stress limits when subjected to existing forces plus the horizontal surcharge effects of the continuous wall footing 10 ft from the face of the sheet piling, if that footing is founded at elevation 713 (approx. 5 ft below grade).

CONCLUSIONS/RECOMMENDATIONS

The allowable vehicle load for the existing structure could be posted at 64,000 pounds gross vehicle weight and a 28,000 pound maximum axle load based on an assumed maximum speed of 20 mph. This is a practical maximum speed attainable based on the proposed site geometry, but consideration could be given to also posting a maximum speed limit.

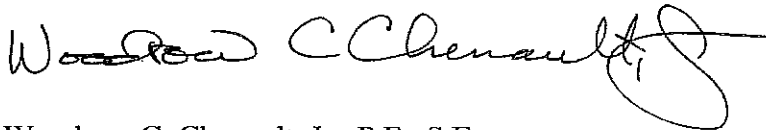
After inspection of the foundation plans and loads for the JSM Development retail/residential facility, it appears that the footings shown in Exhibit 1a are not outside the clear zone for the 5 ft desired footing depth. In addition, the footings are close enough to each other to result in a compounded horizontal surcharge on certain areas of the existing sheet piling. For this reason, it is recommended that deep foundations be utilized for footings 1-11 (except 2 and 4). This could be achieved by founding the spread footings at a lower elevation; or on a practical basis, drilled pier foundations beneath the pile tip elevation may be warranted in these locations. The continuous footings between columns can be founded at elevation 713 (~5 ft below grade) without overstressing the sheet piling if drilled shafts are utilized for the column footings. The proximity of any other footings not shown on Exhibit 1a along the north building perimeter should be checked against the clear zone envelopes to ensure that the bottom of footing lies outside of the relevant envelope, and bottom of footing elevations and/or foundation types should be adjusted accordingly if necessary.

For the Desman parking structure to the north of the existing Boneyard Creek structure, it appears that all footings, except at column line 8, the exterior column line closest to the Boneyard Creek, are a sufficient distance away from the sheet piling so as to not cause a significant horizontal surcharge effect, and could therefore be foundation types/depths that are desirable based on other factors. The footings at 8B, 8C, and 8D are within the clear zone based on a shallow foundation depth of 5 ft, and therefore deep foundations would need to be utilized here. Drilled pier foundations would be recommended for these three footings, at a minimum. For the corner footing at 8A, based on an estimated column load of half the load for the perimeter non-corner footings, it is possible that a shallow spread footing could be utilized, depending on the size of the footing. It may be desirable to utilize the same deep foundation type for all four footings along line 8 in order to found this line on the same bearing stratum.

Please contact us if you have any questions.

Sincerely,

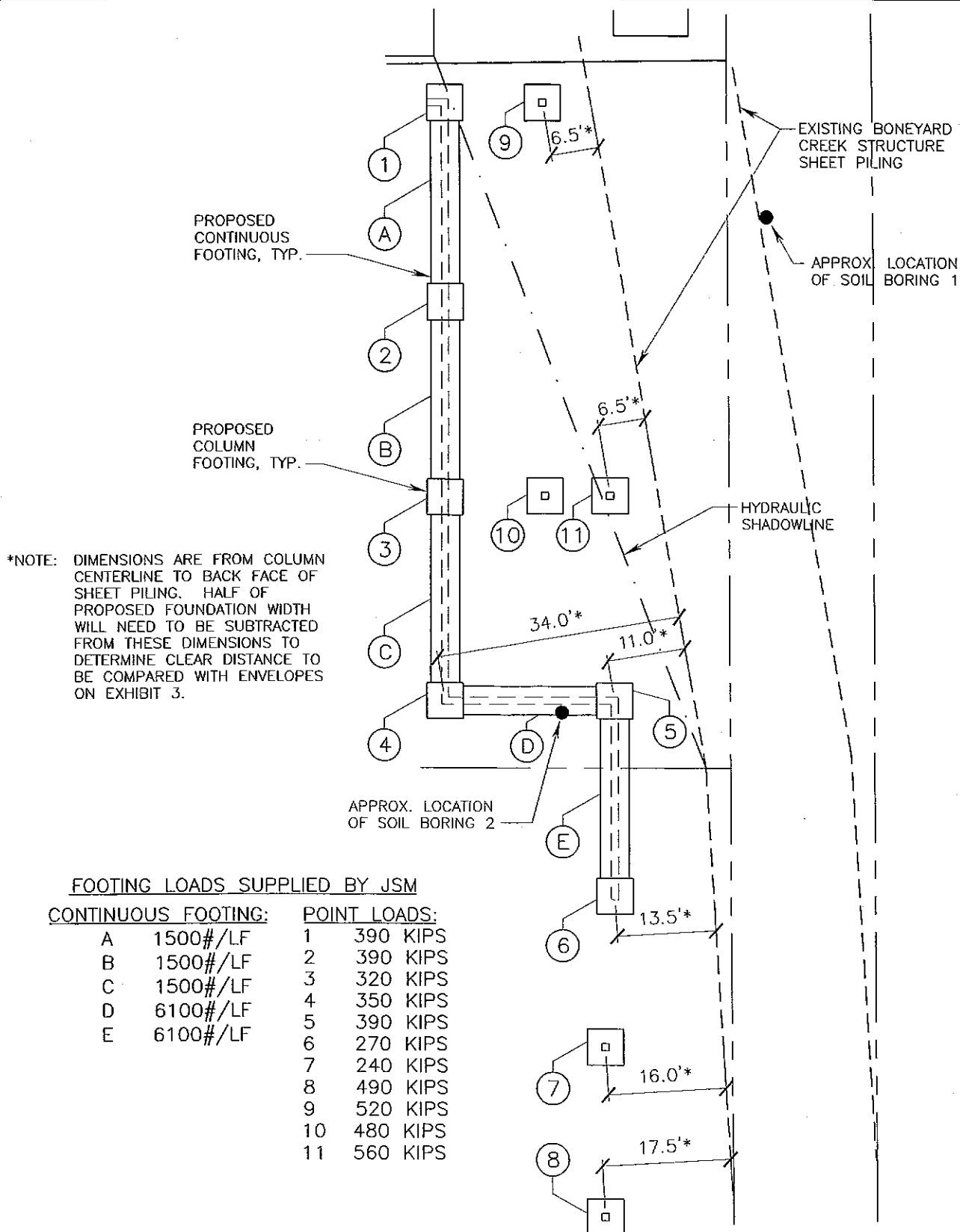
DAILY & ASSOCIATES, ENGINEERS, INC



Woodrow C. Chenault, Jr., P.E., S.E.
Illinois Licensed Structural Engineer No. 3567



- Enc: Exhibit 1a – JSM Development Residential/Retail Facility partial foundation plan and loads
Exhibit 1b – Desman Associates Parking Facility foundation plan and loads
Exhibit 2 – Soil Borings, Existing Structure, 1968 plans
Exhibit 3 – Clear Zone Summary and Existing Structure Cross-Section



FOOTING LOADS SUPPLIED BY JSM

CONTINUOUS FOOTING:	POINT LOADS:
A 1500#/LF	1 390 KIPS
B 1500#/LF	2 390 KIPS
C 1500#/LF	3 320 KIPS
D 6100#/LF	4 350 KIPS
E 6100#/LF	5 390 KIPS
	6 270 KIPS
	7 240 KIPS
	8 490 KIPS
	9 520 KIPS
	10 480 KIPS
	11 560 KIPS



JSM DEVELOPMENT RESIDENTIAL/RETAIL FACILITY PARTIAL FOUNDATION PLAN AND LOADS

SCALE: 1" = 20'



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Date of Preparation:

1-19-05

Designed By

Drawn By

MSJ

Checked By

Approved By

KMN

WCC

Drawing Title

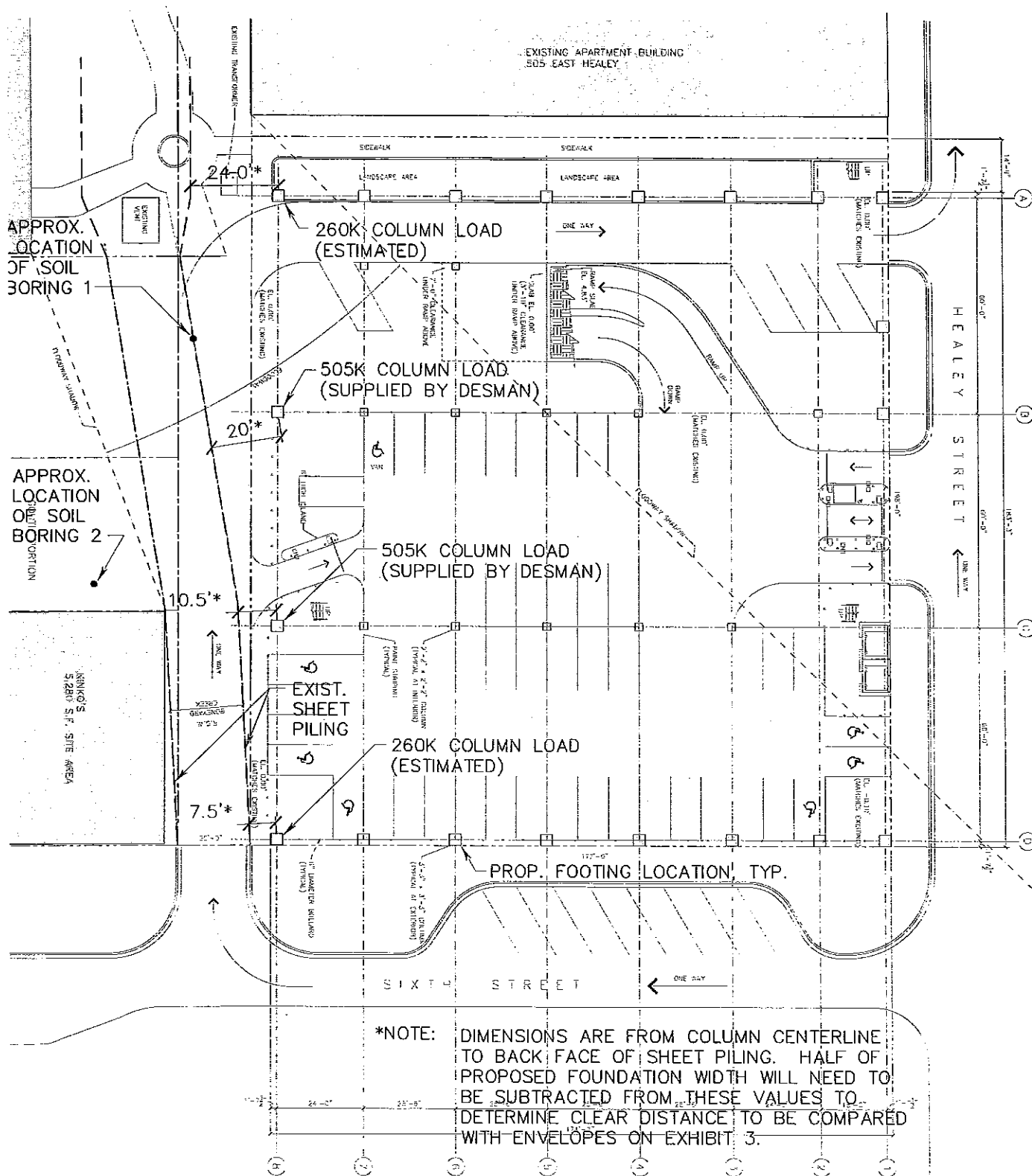
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Project No.

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Sheet No.

of Sheets



DESMAN ASSOCIATES PARKING FACILITY FOUNDATION PLAN & LOADS

SCALE: 1" = 40'



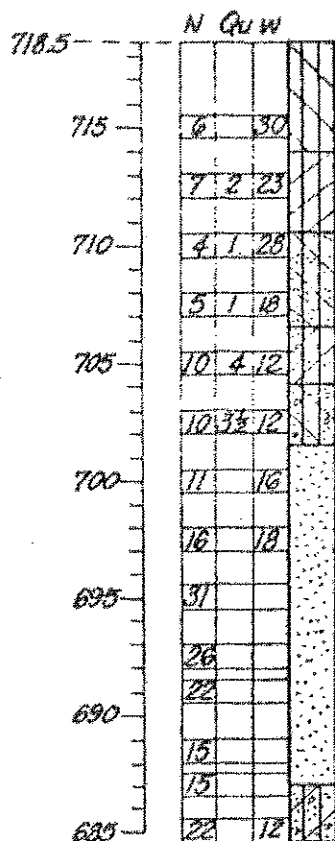
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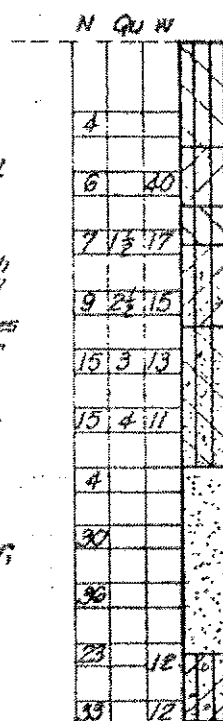
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EXHIBIT 1B

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BORING NO.1



BORING NO.2

SOIL BORINGS - EXISTING STRUCTURE, 1968 PLANS



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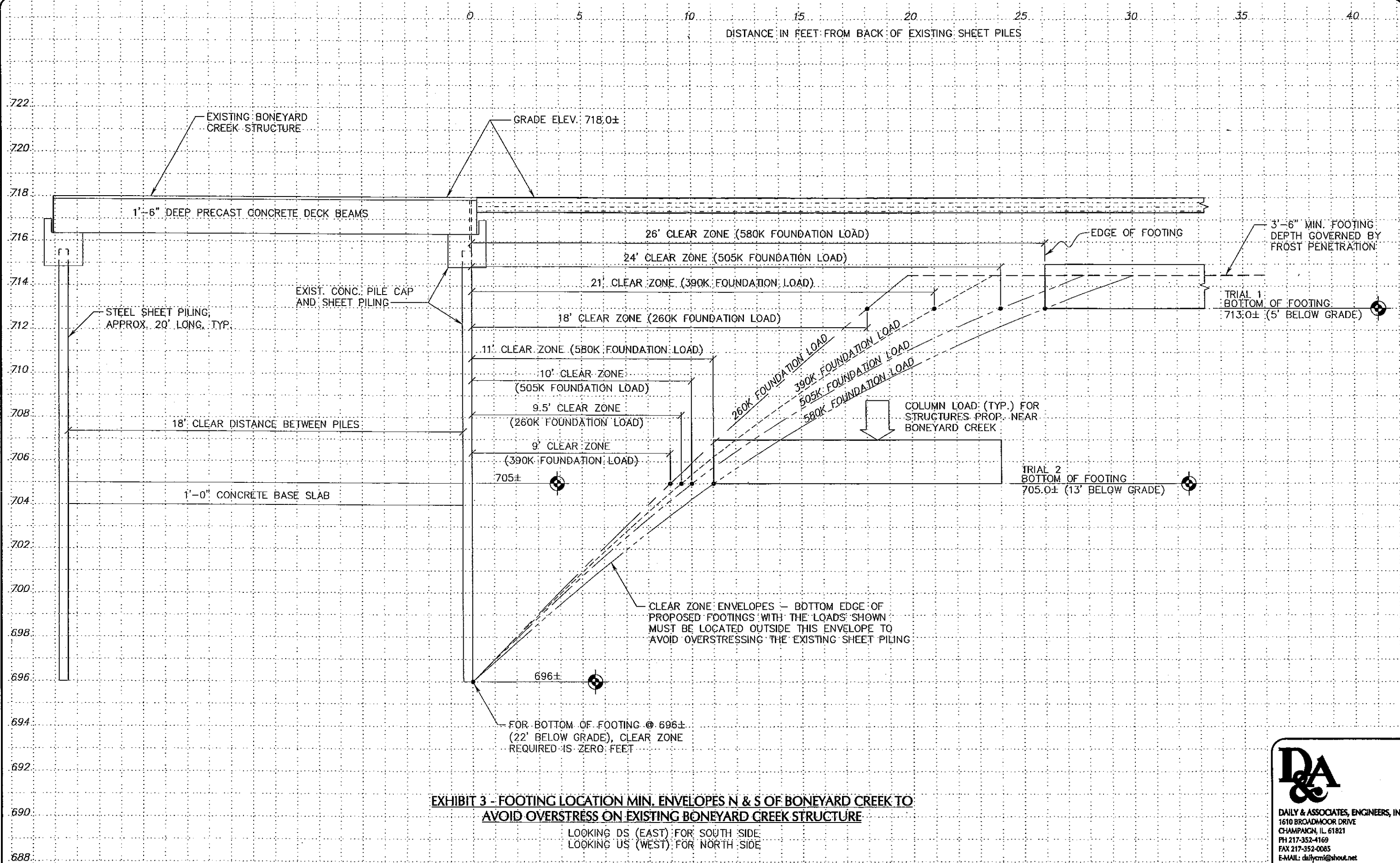
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EXHIBIT 2

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